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SERIES P: TELEPHONE TRANSMISSION QUALITY,
TELEPHONE INSTALLATIONS, LOCAL LINE
NETWORKS

Voice terminal characteristics

Technical requirements and test methods for the universal wired headset or headphone interface of digital mobile terminals

Recommendation ITU-T P.381

ITU-T

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Recommendation ITU-T P.381

Technical requirements and test methods for the universal wired headset or headphone interface of digital mobile terminals

Summary

Recommendation ITU-T P.381 specifies critical physical and electrical-acoustical characteristics for the universal headset interface and provides corresponding test methods. Both 3.5 mm and 2.5 mm diameter headset/headphone interfaces have been widely used in digital mobile terminals in recent years. Nowadays, the consumer is free to choose either the headset/headphone originally provided by the terminal manufacturer or others that are offered separately. However, the quality of service (QoS)/quality of experience (QoE) perceived by users is influenced by both the electrical performance of the interface and the compatibility between the terminal and the connected headset/headphone.

History

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Recommendation ITU-T P.381

Technical requirements and test methods for the universal wired headset or headphone interface of digital mobile terminals

1 Scope

This Recommendation specifies electrical requirements and test methods for the universal analogue headset/headphone interface used in digital mobile terminals.

The principle of this document is to ensure adequate compatibility between the digital mobile terminal and the wired analogue headset/headphone, and to have a better user experience. The universality of the headset/headphone interface will facilitate the separation of sales between digital mobile terminals and headsets/headphones. One of the benefits is that the user can be free to choose his or her favourite type of headset or headphone that is available on the market. In the long run, it will reduce e-waste. Furthermore, the universal interface can be used as the electric coupling design in hands-free systems and hearing aids for wider harmonization.

In order to provide instructions to manufacturers and encourage them to adopt the universal headset interface, the mechanical dimensions are shown in Appendices I, II and III.

This Recommendation is applicable to digital mobile terminals with a physical analogue audio output/input interface. Other similar ICT equipment may also refer to this Recommendation.

This Recommendation is not applicable for terminals designed solely for digital headset/headphone usage.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- | | |
|---------------|--|
| [ITU-T G.122] | Recommendation ITU-T G.122 (1993), <i>Influence of national systems on stability and talker echo in international connections.</i> |
| [ITU-T P.10] | Recommendation ITU-T P.10/G.100 (2006), <i>Vocabulary for performance and quality of service.</i> |
| [ITU-T P.50] | Recommendation ITU-T P.50 (1999), <i>Artificial voices.</i> |
| [ITU-T P.56] | Recommendation ITU-T P.56 (2011), <i>Objective measurement of active speech level.</i> |
| [ITU-T P.57] | Recommendation ITU-T P.57 (2011), <i>Artificial ears.</i> |
| [ITU-T P.58] | Recommendation ITU-T P.58 (2011), <i>Head and torso simulator for telephonometry.</i> |
| [ITU-T P.79] | Recommendation ITU-T P.79 (2007), <i>Calculation of loudness ratings for telephone sets.</i> |
| [ITU-T P.340] | Recommendation ITU-T P.340 (2000), <i>Transmission characteristics and speech quality parameters of hands-free terminals.</i> |

[ITU-T P.380]	Recommendation ITU-T P.380 (2003), <i>Electro-acoustic measurements on headsets</i> .
[ITU-T P.501]	Recommendation ITU-T P.501 (2009), <i>Test signals for use in telephonometry</i> .
[ITU-T P.502]	Recommendation ITU-T P.502 (2000), <i>Objective test methods for speech communication systems using complex test signals</i> .
[ITU-T P.581]	Recommendation ITU-T P.581 (2009), <i>Use of head and torso simulator (HATS) for hands-free and handset terminal testing</i> .
[ITU-T P.863]	Recommendation ITU-T P.863 (2011), <i>Perceptual objective listening quality assessment</i> .
[ITU-T P.863.1]	Recommendation ITU-T P.863.1 (2014), <i>Application guide for Recommendation ITU-T P.863</i> .
[EN 50332-1]	CENELEC EN 50332-1 (2013), <i>Sound system equipment: Headphones and earphones associated with personal music players – Maximum sound pressure level measurement methodology – Part 1: General method for "one package equipment"</i> .
[EN 50332-2]	CENELEC EN 50332-2 (2013), <i>Sound system equipment: Headphones and earphones associated with personal music players – Maximum sound pressure level measurement methodology – Part 2: Matching of sets with headphones if either or both are offered separately, or are offered as one package equipment but with standardised connectors between the two allowing to combine components of different manufacturers or different design</i> .
[ETSI TS 103 106]	ETSI TS 103 106 V1.2.1 (2013), <i>Speech and multimedia Transmission Quality (STQ); Speech quality performance in the presence of background noise: Background noise transmission for mobile terminals-objective test methods</i> .
[IEC 60268-1]	IEC 60268-1 (1985), <i>Sound system equipment – Part1: General</i> .
[IEC 60268-7]	IEC 60268-7 (2010), <i>Sound system equipment – Part 7: Headphones and earphones</i> .
[IEC 61260-1]	IEC 61260-1(2014), <i>Electroacoustics – Octave-band and fractional-octave-band filters. – Part 1: Specifications</i> .
[IEC 61672-1]	IEC 61672-1 (2013), <i>Electroacoustics – Sound level meters – Part 1: Specifications</i> .

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 composite source signal (CSS) [ITU-T P.10]: Signal composed in time by various signal elements.

3.1.2 eardrum reference point (DRP) [ITU-T P.10]: A point located at the end of the ear canal, corresponding to the eardrum position.

3.1.3 earphone [IEC 60268-7]: Electroacoustic transducer by which acoustic oscillations are obtained from electric signals and intended to be closely coupled acoustically to the ear.

3.1.4 headset [ITU-T P.10]: A device which includes a telephone receiver and transmitter which is typically secured to the head or the ear of the wearer.

3.1.5 mouth reference point (MRP) [ITU-T P.10]: Point 25 mm in front of and on the axis of the lip plane of the artificial mouth or a typical human mouth (see Figure 1 of ITU-T P.64).

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 artificial ear: A device which incorporates an acoustic coupler and a calibrated microphone for measuring sound pressure, and which has an overall acoustic impedance similar to that of the average adult ear over a given frequency band (based on the definition in [ITU-T P.10]).

3.2.2 codec: Combination of an analogue-to-digital encoder and a digital-to-analogue decoder operating in opposite directions of transmission in the same equipment.

3.2.3 head and torso simulator (HATS) for telephonometry: A manikin that extends downwards from the top of the head to the waist. It is designed to simulate the sound pick-up characteristics and the acoustic diffraction produced by the average adult, and to reproduce the acoustic field generated by the human mouth (based on the definition in [ITU-T P.10]).

3.2.4 headphone: An object based on the assembly of one or two earphones on a headband or chinband, the use of which may be optional (e.g., with intra-concha earphones) (based on the definition in [IEC 60268-7]).

3.2.5 mean opinion score – listening-only quality objective (MOS-LQO): The score is calculated by means of an objective model which aims at predicting the quality for a listening-only test situation. Objective measurements made using the model given in [ITU-T P.863] give results in terms of MOS-LQO.

3.2.6 receive: The receiving direction of the signal transmission, usually from the measurement system to the device under test (DUT).

3.2.7 send: The sending direction of the signal transmission, usually from the device under test (DUT) to the measurement system.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ABT	Audio Breakthrough Testing
AGC	Automatic Gain Control
$A_{H,R,dt}$	Attenuation range in the receive direction during double talk
$A_{H,S,dt}$	Attenuation range in the send direction during double talk
dBFS	decibels relative to Full Scale.
dBV	decibels relative to 1 Volt
dBVp	decibels relative to 1 Volt, psophometrically weighted
DRP	Drum Reference Position
DUT	Device Under Test
EC	Echo Cancellor
ECM	Electret condenser microphone
EL	Echo Loss

EMI	Electromagnetic Interference
ESD	Electrostatic Discharge
FFT	Fast Fourier Transform
GND	Ground
HATS	Head and Torso Simulator
HTCL _w	Headset Terminal Coupling Loss weighted
JFET	Junction Field Effect Transistor
L	Left audio channel
L _{sendnom}	Level in send for nominal speech input level
L _{nominal}	nominal input Level
L _{S,min}	minimum activation Level in the send direction
L _{R,min}	minimum activation Level in the receive direction
LQ	Listening Quality
LQO	Listening Quality Objective
LQ _R	Listening Quality in the receive direction
LQ _S	Listening Quality in the send direction
LQOn	Listening Quality Objective, narrowband
LQOs	Listening Quality Objective super-wideband
LSB	Lowest Significant Bit
MIC	Microphone
MONO	Mono Audio Channel
MOS	Mean Opinion Score
MRP	Mouth Reference Point
NLP	Non-linear Processing
POI	Point of Interconnection
R	Right audio channel
R _{bias}	bias Resistance
SNR	Signal to Noise Ratio
STMR	Sidetone Masking Rating
TCL	Terminal Coupling Loss
TCL _w	weighted Terminal Coupling Loss
TELRdt	Talker Echo Loudness Rating under double talk conditions
T _S	delay in the sending direction
T _{r,S,min}	Minimum built-up time in Send
T _R	delay in the receiving direction
T _{TES}	system delay
UE	User Equipment

V_m	maximum output voltage
SPCV	Simulated programme signal characteristic voltage

5 General description

Generally, if a headset or a headphone is used, the overall user experience during a call highly depends on both the terminal and the connected headset/headphone. Although the acoustic quality of the headset/headphone is usually the weak link, more consideration with regard to the physical and electrical performance of the universal interface is needed.

This Recommendation specifies the universal concentric connector interface for successful interconnection between the digital mobile terminal and the headset/headphone, including the plug connector and the socket connector. Normally, the socket connector is fixed inside the terminal, with the outside rim level with the surrounding shell of the terminal. Particularly, if the outside rim is lower than the surrounding shell, the dimension of the plug hand grip shall not influence the precise mating.

6 Physical characteristics

6.1 General rules

Two types of concentric socket connectors are recommended for use, the 2.5 mm and the 3.5 mm diameter socket connectors. Isometric view of the plug and the socket connector are shown in Figure 6-1:

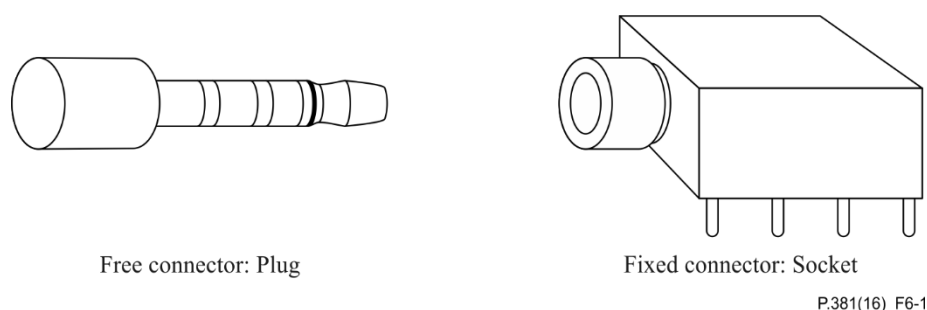


Figure 6-1 – Isometric view of the plug and socket connector

If the terminal is equipped with a headset interface and designed for both communication and audio-playing, the fixed connector shall be a 3.5 mm diameter or 2.5 mm diameter concentric socket connector with four contact points. Detailed dimension information about the socket connector with four contact points is given in Appendix I. Some terminals with curved edges may not work well with the dimensions given in Appendix I. For these cases, optional dimensions are given in Appendix II, which is fully compatible with connectors designed to the dimensions of Appendix I.

Although socket connectors with three contact points are no longer recommended for digital mobile terminals, dimension information about these connectors is given in Appendix III to help achieve complete compatibility.

NOTE – The contact points here do not include special points reserved for other functions.

6.2 Pin assignments

This clause gives an illustration of pin assignments of the socket connector with four contact points and those of the mated plug, as shown in Figure 6-2.

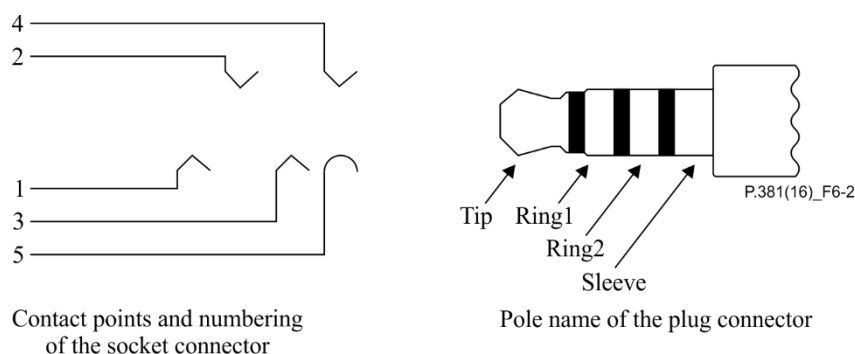


Figure 6-2 – Pin assignments of a socket connector with four contact points

The physical pinout order of the universal interface is important and should coordinate with the connected headset/headphone.

A socket connector with four contact points shall be compatible with both the plug connector with three poles and the plug connector with four poles specified in this Recommendation.

There are two types of headsets with different pin assignments commonly used today across geographical regions. Depending on the status, it was recommended that terminals should be able to identify both plugs intelligently and automatically.

6.2.1 Recommended pin assignment

Point 1 of the socket is to be connected to the tip of the plug, linking it to the left-hand channel of the receiver (L audio). Point 2 is to be connected to Ring 1, linking it to the right-hand channel of the receiver (R audio). Point 3 is to be connected to Ring 2, linking it to the transducer (MIC+). Points 4 and 5 are to be connected to the sleeve, linking it to ground (GND).

Referring to Figure 6-2:

- 1 is the contact point of the tip, linking it to the left-hand channel of the receiver (L audio).
- 2 is the contact point of Ring 1, linking it to the right-hand channel of the receiver (R audio).
- 3 is the contact point of Ring 2, linking it to the transducer (MIC+).
- 4 is the contact point of the sleeve, linking it to the GND.
- 5 is the bushing of the socket, linking it to the GND when it is made of conductive material.

It is recommended that the headset pole order from the tip to the sleeve is: L/R/MIC/GND.

It is agreed that the pinout order of L/R/MIC/GND has an advantage in electrostatic discharge (ESD) protection and allows for both plastic and metallic convertors.

6.2.2 Alternate pin assignment

Point 1 of the socket is to be connected to the tip of the plug, linking it to the left-hand channel of the receiver (L audio). Point 2 is to be connected to Ring 1, linking it to the right-hand channel of the receiver (R audio). Points 3 and 5 are to be connected to Ring 2, linking it to GND. Point 4 is to be connected to the sleeve, linking it the transducer (MIC+).

Referring to Figure 6-2:

- 1 is the contact point of the tip, linking it to the left-hand channel of the receiver (L audio).
- 2 is the contact point of Ring 1, linking it to the right-hand channel of the receiver (R audio).
- 3 is the contact point of Ring 2, linking it to the GND.
- 4 is the contact point of the sleeve, linking it to the transducer (MIC+).
- 5 is the bushing of the socket, linking it to the GND when it is made of conductive material.

The pinout order from the tip to the sleeve for the alternate headset plug is: L/R/GND/MIC.

7 Electrical interface specification

7.1 Communication mode

7.1.1 Test set-up

Test set-ups are shown in Figures 7-1 and 7-2.

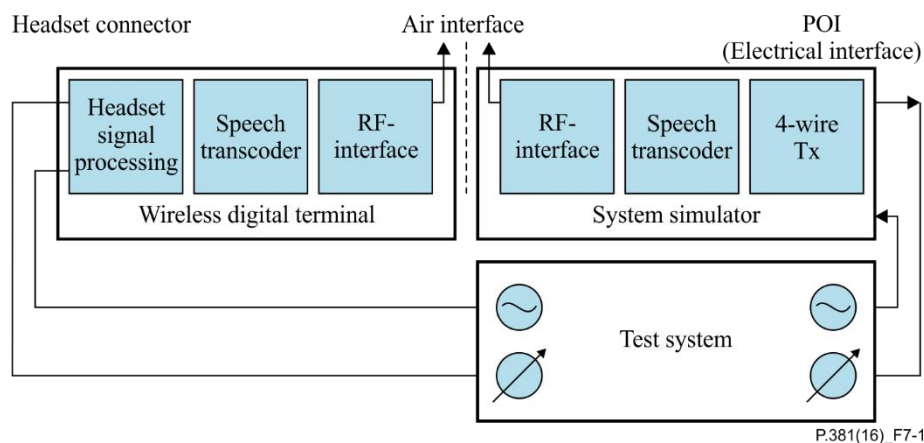


Figure 7-1 – Test set-up for testing the electrical headset interface

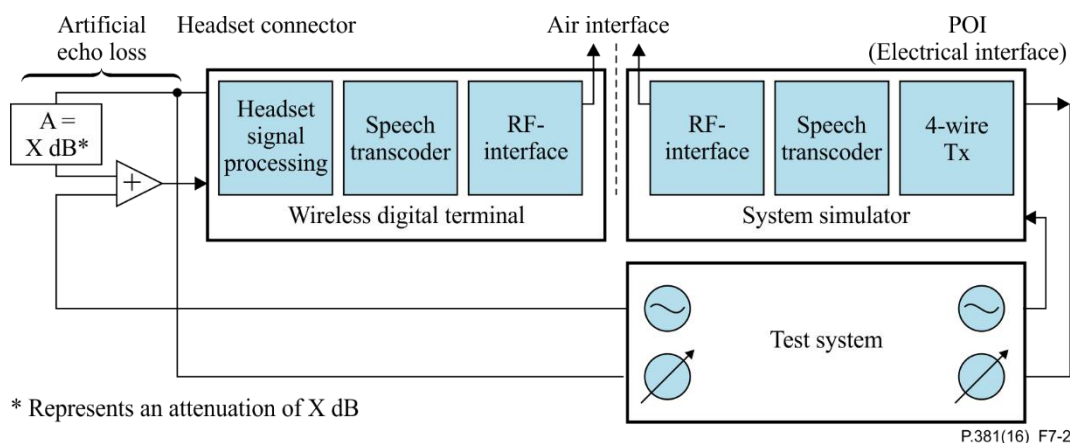


Figure 7-2 – Test set-up with artificial echo loss for echo and double talk testing

7.1.1.1 Input and output characteristics of the test system for connecting to the headset connector

The output of the test system connected to the interface in Send of the headset connector must be DC resistant. The output impedance shall be between 1 Ω and 10 k Ω . The dynamic range of the test system shall be consistent with (or exceed) the level range provided by headset microphones.

The input of the test system connected to the receiving interfaces of the headset connectors shall have an input impedance of 32 Ω . The dynamic range shall be consistent with (or exceed) the output level range provided by the electrical output of digital mobile terminals' headset outputs.

The common ground impedance (between sending and receiving sides) for the test system shall be $\leq 0.05 \Omega$.

7.1.1.2 Test signals and test signal levels

Unless otherwise specified, fullband real speech signals, which can be found in [ITU-T P.501], are used for measurements. Detailed information about the test signal used can be found in the corresponding clause of [ITU-T P.501]. For test cases where composite source signals are specified, the speech-spectrum-shaped CSS signals specified in [ITU-T P.501] shall be used.

All test signals – which are used in Receive – have to be band-limited. The band limitation is achieved by bandpass filtering in the frequency range between 100 Hz and 4 kHz using a bandpass filter providing ≥ 24 dB/octave for narrowband mode. In wideband mode, the band limitation is achieved by bandpass filtering in the frequency range between 100 Hz and 8 kHz, using a bandpass filter providing ≥ 24 dB/octave. In super-wideband mode, the band limitation is achieved by bandpass filtering in the frequency range between 50 Hz and 16 kHz, using a bandpass filter providing ≥ 24 dB/octave. In fullband mode, the band limitation is achieved by bandpass filtering in the frequency range between 20 Hz and 20 kHz, using a bandpass filter providing ≥ 24 dB/octave. In Send, the test signals are used without band limitation.

For real speech, the test signal levels are referred to the [ITU-T P.56] active speech level of the (band limited in receiving direction) test signal, calculated over the complete test sequence, unless described otherwise. For other test signals, the test signal levels are referred to the average level of the (band limited in receiving direction) test signals, averaged over the complete test sequence length.

Unless stated otherwise, the nominal average signal levels for the measurements are as follows:

- –16 dBm0 in Receive.
- –60 decibels relative to 1 Volt (dBV) in Send (typical equivalent microphone signal level corresponding to –4.7 dBPa at the mouth reference point (MRP)).
- The receive volume control is adjusted to the setting that produces the level closest to –39 dBV considering binaural headsets.

NOTE – If different networks' signal levels are to be used in tests, this is to be stated in individual test. The "Lombard effect" (increased talker speech level due to high background noise) is considered in the background noise tests.

Some tests require exact synchronization of test signals in the time domain. Therefore, it is required to take into account the delays of the terminals. When analysing signals, any delay introduced by the test system, codecs and terminals have to be taken into account accordingly.

7.1.2 Delay

7.1.2.1 Requirements

In view of the following considerations:

- that delay has an impact on echo performance and the dynamics of voice conversation;
- that the amount of delay introduced by wireless systems depends on specific technology and may be inherent to the adopted coding technique,

the following is recommended:

- delay added by the terminal equipment should be minimized in accordance with the guidelines provided in [ITU-T G.114] even with the use of echo control;
- the terminal specific implementation dependent delay, including both the delay in sending direction and the delay in receiving direction, should be less than 70 ms. That means the sum of overall terminal delay in Send T_s and overall terminal delay in Receive T_r , should be less than $70 \text{ ms} + T_{as} + T_{ar}$. (T_{as} is the implementation independent system delay in Send and T_{ar} is the implementation independent system delay in Receive).

NOTE 1 – The overall terminal delay consists of the implementation independent system delay and the implementation dependent delay. The implementation independent system delay is introduced by the specific accessing technology in air interface and the coding technique in both sending and receiving directions. The implementation dependent delay is introduced by the speech processing, data transport/handling, speech enhancement, audio filtering, etc., in both sending and receiving directions, it is obtained by excluding implementation independent system delay from the measured overall terminal delay.

NOTE 2 – For 3GPP UMTS circuit-switched speech and 3GPP LTE MTSI-based speech, definitions, performance objectives and requirements are found in [b-3GPP TS 26.131].

7.1.2.2 Test

7.1.2.2.1 Test of overall terminal delay in Send

- 1) The test signal to be used for the measurements shall be a composite source signal (CSS), as described in [ITU-T P.501]. The test signal consists of the voiced part followed by a pseudo random noise sequence with a minimum periodicity of 500 ms.
- 2) The test signal level shall be -60 dBV, measured at the sending input of the headset interface.
- 3) The delay is calculated using the cross-correlation function between the signal at the terminal input and the signal at the system simulator output.
- 4) The measurement is corrected by the delay introduced by the test equipment (T_s, sys). The sending delay (T_s, wdt) is expressed in milliseconds, determined from the maximum of the cross-correlation function.

7.1.2.2.2 Test of overall terminal delay in Receive

- 1) The test signal to be used for the measurements shall be a composite source signal (CSS), as described in [ITU-T P.501]. The test signal consists of the voiced part followed by a pseudo random noise sequence with a minimum periodicity of 500 ms.
- 2) The test signal level shall be -16 dBm0, measured at the digital reference point.
- 3) The delay is calculated using the cross-correlation function between the signal at the terminal input and the signal at the system simulator output. The measurement is corrected by the delay introduced by the test equipment (T_r, sys).
- 4) The receiving delay (T_r, wdt) is expressed in milliseconds, determined from the maximum of the cross-correlation function.

7.1.3 Level in Send for nominal speech input level

7.1.3.1 Requirements

The sending level is measured at the point of interconnection (POI) (output of the reference speech decoder of the system simulator).

The sending level shall be -16 dBm0 ± 3 dB when inserting the sending signal at the nominal level, as described in clause 7.1.1.2.

7.1.3.2 Test

- 1) The test arrangement is according to clause 7.1.1, Figure 7-1.
- 2) The test signal used for the measurements shall be the British-English single talk sequence described in clause 7.3.2 of [ITU-T P.501]. The test signal level is the active speech level according to [ITU-T P.56].
- 3) The active speech level at the electrical reference point (POI) is measured.
- 4) The sending level is expressed in dBm0.

7.1.4 Level in Receive for nominal speech input level

7.1.4.1 Requirements

The receiving level is measured at the receiving output of the headset interface.

The receiving level shall be $-30 \text{ dBV} \pm 6 \text{ dB}$ at the maximum volume setting when inserting the receiving signal at nominal level, as described in clause 7.1.1.2.

The receiving level shall be $-39 \text{ dBV} \pm 3 \text{ dB}$ at the nominal volume setting when inserting the receiving signal at nominal level, as described in clause 7.1.1.2.

The receiving level shall be $-55 \text{ dBV} \pm 6 \text{ dB}$ at the minimum volume setting when inserting the receiving signal at nominal level, as described in clause 7.1.1.2.

7.1.4.2 Test

- 1) The test arrangement is according to clause 7.1.1, Figure 7-1.
- 2) The test signal used for the measurements shall be the British-English single talk sequence described in clause 7.3.2 of [ITU-T P.501]. The test signal level is the active speech level according to [ITU-T P.56].
- 3) For the calculation, the active level at the sending output of the headset interface is used.
- 4) The receiving level is expressed in dBV.

The measurement is repeated for the second channel.

7.1.5 Level in Send for low and high speech input levels

7.1.5.1 Requirements

The sending level is measured at the POI (output of the reference speech decoder of the system simulator). The test result is compared to the test result level in send for nominal speech input level (L_{sendnom}) obtained for the nominal input level (L_{nominal}) described in clause 7.1.3. The results should be according to Table 7-1.

Table 7-1 – Limits for Level in Send for low and high speech input levels

Input level [dBV]	Upper limit [dBm0]	Lower limit [dBm0]
$L_{\text{nominal}} - 10$	$L_{\text{sendnom}} - 5$	$L_{\text{sendnom}} - 12$
$L_{\text{nominal}} + 5$	$L_{\text{sendnom}} + 7$	$L_{\text{sendnom}} + 0$

7.1.5.2 Test

- 1) The test arrangement is according to clause 7.1.1, Figure 7-1.
- 2) The test signal used for the measurements shall be the British-English single talk sequence described in clause 7.3.2 of [ITU-T P.501]. The test signal level is the active speech level according to [ITU-T P.56], adjusted as described in clause 7.1.5.1.
- 3) The active speech level at the electrical reference point (POI) is measured.
- 4) The sending level is expressed in dBm0 and compared to the limits described in clause 7.1.5.1.

7.1.6 Linearity in Receive

(provisional, for further study)

7.1.7 Sending frequency response

7.1.7.1 Requirements

The sending frequency response is measured from the sending input of the headset interface to the POI (input of the reference speech coder of the system simulators). Considering the special location of the headset microphone, the sending frequency response should provide an allowance for a high-frequency boost in order to comply with a large variety of headsets, which in combination with the digital mobile terminal should comply with the relevant standards in Send.

The measured frequency response shall be within the limits as defined in Table 7-2 for narrow band, Table 7-3a for wideband, Table 7-3b for super-wideband and Table 7-3c for full band.

Table 7-2 – Tolerance mask for the narrowband sending frequency response

Frequency (Hz)	Upper limit	Lower limit	Target
100	−9	−∞	−20
200	3	−∞	−5
300	3	−3	0
1 000	5	−3	1
3 100	11	3	7
3 400	12	−5	4
4 000	12	−∞	

NOTE 1 – All sensitivity values are expressed in dB on an arbitrary scale.
NOTE 2 – The limits for intermediate frequencies lie on a straight line drawn between the given values on a logarithmic (frequency) – linear (dB) scale.
NOTE 3 – The sending frequency response should have allowance for a high-frequency boost considering typical variations in mouth-to-microphone transfer characteristics.
NOTE 4 – The target response assumes the system under test uses the AMR-NB [b-3GPP TS 26.071] codec operating at 12.2 kbit/s.

Table 7-3a – Tolerance mask for the wideband sending frequency response

Frequency (Hz)	Upper limit	Lower limit	Target
100	−3	−∞	−12
200	3	−3	0
1 000	3	−3	0
3 000	10	2	6
5 000	12	2	7
6 300	12	0	5
8 000	12	−∞	

NOTE 1 – All sensitivity values are expressed in dB on an arbitrary scale.
NOTE 2 – The limits for intermediate frequencies lie on a straight line drawn between the given values on a logarithmic (frequency) – linear (dB) scale.
NOTE 3 – The sending frequency response should have allowance for a high-frequency boost considering typical variations in mouth-to-microphone transfer characteristics.
NOTE 4 – The target response assumes the system under test uses the AMR-WB [b-ITU-T G.722.2] codec operating at 12.65 kbit/s.

Table 7-3b – Tolerance mask for the super-wideband sending frequency response

Frequency (Hz)	Upper limit	Lower limit	Target
100	[3]		[0]
200	[3]	[−3]	[0]
1 000	[3]	[−3]	[0]
3 000	[8]	[0]	[4]
5 000	[10]	[0]	[5]
8 000	[10]	[0]	[6]
12 500	[10]	[−1]	[6]
16 000	[10]		

NOTE 1 – All sensitivity values are expressed in dB on an arbitrary scale.

NOTE 2 – The limits for intermediate frequencies lie on a straight line drawn between the given values on a logarithmic (frequency) – linear (dB) scale.

NOTE 3 – The sending frequency response should have allowance for a high-frequency boost considering typical variations in mouth-to-microphone transfer characteristics.

NOTE 4 – The target response assumes the system under test uses the EVS [b-3GPP TS 26.441] codec operating in super-wideband mode at 24.4 kbit/s.

NOTE 5 – Values within square brackets [] are provisional and require further validation.

Table 7-3c – Tolerance mask for the fullband sending frequency response

Frequency (Hz)	Upper limit	Lower limit	Target
100	[3]		[0]
200	[3]	[−3]	[0]
1 000	[3]	[−3]	[0]
3 000	[8]	[0]	[4]
5 000	[10]	[0]	[5]
8 000	[10]	[0]	[6]
12 500	[10]	[−1]	[6]
20 000	[10]	[−3]	[4]

NOTE 1 – All sensitivity values are expressed in dB on an arbitrary scale.

NOTE 2 – The limits for intermediate frequencies lie on a straight line drawn between the given values on a logarithmic (frequency) – linear (dB) scale.

NOTE 3 – The sending frequency response should have allowance for a high-frequency boost considering typical variations in mouth-to-microphone transfer characteristics.

NOTE 4 – The target response assumes the system under test uses the EVS [b-3GPP TS 26.441] codec operating in fullband mode at 24.4 kbit/s.

NOTE 5 – Values within square brackets [] are provisional and require further validation.

7.1.7.2 Test

- 1) The test arrangement is according to clause 7.1.1, Figure 7-1.
- 2) The test signal used for the measurements shall be the British-English single talk sequence described in clause 7.3.2 of [ITU-T P.501]. The test signal level is the nominal signal level, applied to the sending input of the headset interface.

The power density spectrum at the sending input of the headset interface is used as the reference power density spectrum for determining the sending sensitivity.

- 3) In full band, the sending sensitivity is determined in third octave intervals, as given by [IEC 61260-1] for frequencies from 100 Hz to 20 kHz inclusive, measured at the POI. In super-wideband, it is determined for frequencies from 100 Hz to 16 kHz. In wideband, it is determined for frequencies from 100 Hz to 8 kHz. In narrow band, it is determined for frequencies from 100 Hz to 4 kHz. In each third octave band, the level of the measured signal is referred to the level of the reference signal.
- 4) The sensitivity is determined in dBV/V.

7.1.8 Receiving frequency response

7.1.8.1 Requirements

The receiving frequency response is measured from the POI (output of the reference speech coder of the system simulators) to the receiving output of the headset interface. The receiving sensitivity response should be mostly flat in the entire frequency range in order to comply with a large variety of headsets, which in combination with the digital mobile terminal should comply with the relevant standards in Receive.

The measured frequency response shall be within the limits as defined in Table 7-4 for narrow band, Table 7-5a for wideband, Table 7-5b for super-wideband and Table 7-5c for full band.

Table 7-4 – Tolerance mask for the narrowband receiving frequency response

Frequency (Hz)	Upper limit	Lower limit	Target
100	2	$-\infty$	–
200	2	$-\infty$	0
300	2	–6	0
1 000	2	–2	0
2 000	6	–2	–1
3 400	6	–5	–1.5
4 000	6	$-\infty$	–

NOTE 1 – All sensitivity values are expressed in dB on an arbitrary scale.

NOTE 2 – The limits for intermediate frequencies lie on a straight line drawn between the given values on a logarithmic (frequency) – linear (dB) scale.

NOTE 3 – The target response assumes the system under test uses the AMR-NB [b-3GPP TS 26.071] codec operating at 12.2 kbit/s.

Table 7-5a – Tolerance mask for the wideband receiving frequency response

Frequency (Hz)	Upper limit	Lower limit	Target
100	2	$-\infty$	0
200	2	–7	0
300	2	–5.5	0
1 000	2	–2	0
2 000	2	–2	–0.5
5 000	2	–6	–4
6 300	2	–12	–6
8 000	2	$-\infty$	–

Table 7-5a – Tolerance mask for the wideband receiving frequency response

NOTE 1 – All sensitivity values are expressed in dB on an arbitrary scale. The limits for intermediate frequencies lie on straight lines drawn between the given values on a linear (dB) – logarithmic (Hz) scale.

NOTE 2 – The target response assumes the system under test uses the AMR-WB [b-ITU-T G.722.2] codec operating at 12.65 kbit/s.

Table 7-5b – Tolerance mask for the super-wideband receiving frequency response

Frequency (Hz)	Upper limit	Lower limit	Target
100	[2]		[0]
200	[2]	[–7]	[0]
1 000	[2]	[–5.5]	[0]
3 000	[2]	[–2]	[0]
5 000	[2]	[–2]	[0]
8 000	[2]	[–3]	[–1]
12 500	[2]	[–6]	[–2]
16 000	[2]		

NOTE 1 – All sensitivity values are expressed in dB on an arbitrary scale. The limits for intermediate frequencies lie on straight lines drawn between the given values on a linear (dB) – logarithmic (Hz) scale.

NOTE 2 – The target response assumes the system under test uses the EVS [b-3GPP TS 26.441] codec operating in super-wideband mode at 24.4 kbit/s.

NOTE 5 – Values within square brackets [] are provisional and require further validation.

Table 7-5c – Tolerance mask for the fullband receiving frequency response

Frequency (Hz)	Upper limit	Lower limit	Target
100	[2]		[0]
200	[2]	[–7]	[0]
1 000	[2]	[–5.5]	[0]
3 000	[2]	[–2]	[0]
5 000	[2]	[–2]	[0]
8 000	[2]	[–3]	[–1]
12 500	[2]	[–4]	[0]
20 000	[2]	[–7]	[–2]

NOTE 1 – All sensitivity values are expressed in dB on an arbitrary scale. The limits for intermediate frequencies lie on straight lines drawn between the given values on a linear (dB) – logarithmic (Hz) scale.

NOTE 2 – The target response assumes the system under test uses the EVS [b-3GPP TS 26.441] codec operating in fullband mode at 24.4 kbit/s.

NOTE 5 – Values within square brackets [] are provisional and require further validation.